

or two or three degrees, and all these points in this science are of great value.

I have looked up the literature of the subject both English, Canadian and German, and I find there are considerable differences on this point. For instance Sorenburg, who is a very competent bacteriologist and who is Surgeon-General of the United States Army, finds that the spores of the bacillus alvei are killed at the boiling temperature, 212 degrees when exposed for the length of four minutes.

Prof. Howard finds it requires a temperature approaching 212 for forty-five minutes. My experiments have confirmed neither of them; I have not been able to kill them in four minutes; but I have been able to kill them in 45 minutes. I cannot get a temperature above between 98 and 99—about 98.7 centigrade, or in Fahrenheit about 208, at Guelph—208 to 210; I cannot get the exact boiling temperature, but I can get it by using steam under pressure. I have used both of these methods and I find by using the same method as Sorenburg has employed and trying the ordinary boiling temperature at Guelph that they are killed in about 40 minutes. By using steam the lowest I have gotten is ten minutes. So probably Sorenburg's method is all right. There is a difference in the method. If I use Sorenburg's method with the steam I could not very well manage it. I have to use large test tubes for the similar experiment, and using that I cannot use these very fine tubes, but simply glass drawn out very fine into capillary tubes and just heated sufficiently to drive out the air and then it sucks up a portion of the beef broth culture. Then, there are about two or three drops in a very small tube, which is very thin, and the heat quickly penetrates it, by using that method in the ordinary boiling temperature of Guelph, I find it takes a little under forty minutes to kill them.

By using the test tube I told you about with about two inches of beef broth in it and exposing it to an actual temperature of 212 I have succeeded in killing them in about twelve minutes. Dry heat is, however, far different. I have exposed germs on cover slips, that I have mentioned to you, for an hour and a half at a temperature of about 280 degrees Fahrenheit; I use a centigrade thermometer; that is 50 degrees in centigrade above boiling point; they will stand a temperature of an hour and a half in that degree. That concludes my work on that proposition.

Proposition No. 5 of Prof. Howard's is as follows: "That honey stored by the bees in these foul cells and sometimes capped, thereby retaining the germs of foul brood as long as the comb lasts; that the honey

in these cells is not detrimental to the vitality of either the spores or bacilli which are productive of the disease, and that in such cells the spores and bacilli are found suspended in the honey still retaining their vitality."

I have isolated from a number of different cells containing honey the foul brood germ; I have also isolated time and again from bee bread from the pollen mass. Two or three combs I had at the commencement of my experiments were very rotten indeed. Also with reference to the honey that was in them, I took very careful precautions to sterilize, if they were sealed, the cover, and the sealing, taking it off with great precautions and using the honey from the bottom of the cell, and I succeeded time and again in getting cultures of the bacillus alvei matter and also just as frequently from the bee bread. Further I had two samples of honey analyzed. Mr. Holtermann sent me a sample of buckwheat honey and also a sample of clover honey with a slight mixture of buckwheat honey; it was just enough to slightly discolor it.

Mr. Holtermann—It was about five per cent.

Prof. Harrison—This honey I analyzed to find if there was formic acid in it and if there was, how much there was. One of the German authorities states that there is about 25 per cent of formic acid in honey. I find that he is perfectly correct in his assumption that there is formic acid present in honey, but different samples vary. In the sample of buckwheat honey 15 grammes of pure formic acid was found in 100 grammes of the honey. In clover honey there was far less. 0579 grammes of formic acid in 100 grammes of this honey. The honey does not serve as a food for the bacillus alvei therefore I made up solutions of agar, and in it I placed the exact amount that was found in the buckwheat honey and also in the clover honey; that is, I made up two-lots; I took 100 grammes of agar which is equivalent to 100 grammes of honey, and in it I placed the 15 grammes formic acid; it changed the color of the agar to a sort of milkiness; it is generally semi-transparent; this I will call strong formic agar; I also made up 100 grammes of agar containing 0579 grammes, which is equivalent to the same amount as was found in the clover sample. So, you see I had a strong formic agar and a weak formic agar, and then cultures of the bacillus were taken—I have cultures in my laboratory of this germ separately cultivated from about ten different sources, from Ontario, from Florida, from Michigan, from Germany and from Austria—I made sufficient

(To be continued).